February 21, 1899.

Prof. G. B. Howes, LL.D., F.R.S., Vice-President, in the Chair.

The following papers were read :—

1. On a Portion of Mammalian Skin, named *Neomylodon listai*, from a Cavern near Consuelo Cove, Last Hope Inlet, Patagonia. By Dr. F. P. Moreno, C.M.Z.S. With a Description of the Specimen by A. Smith Woodward, F.Z.S.

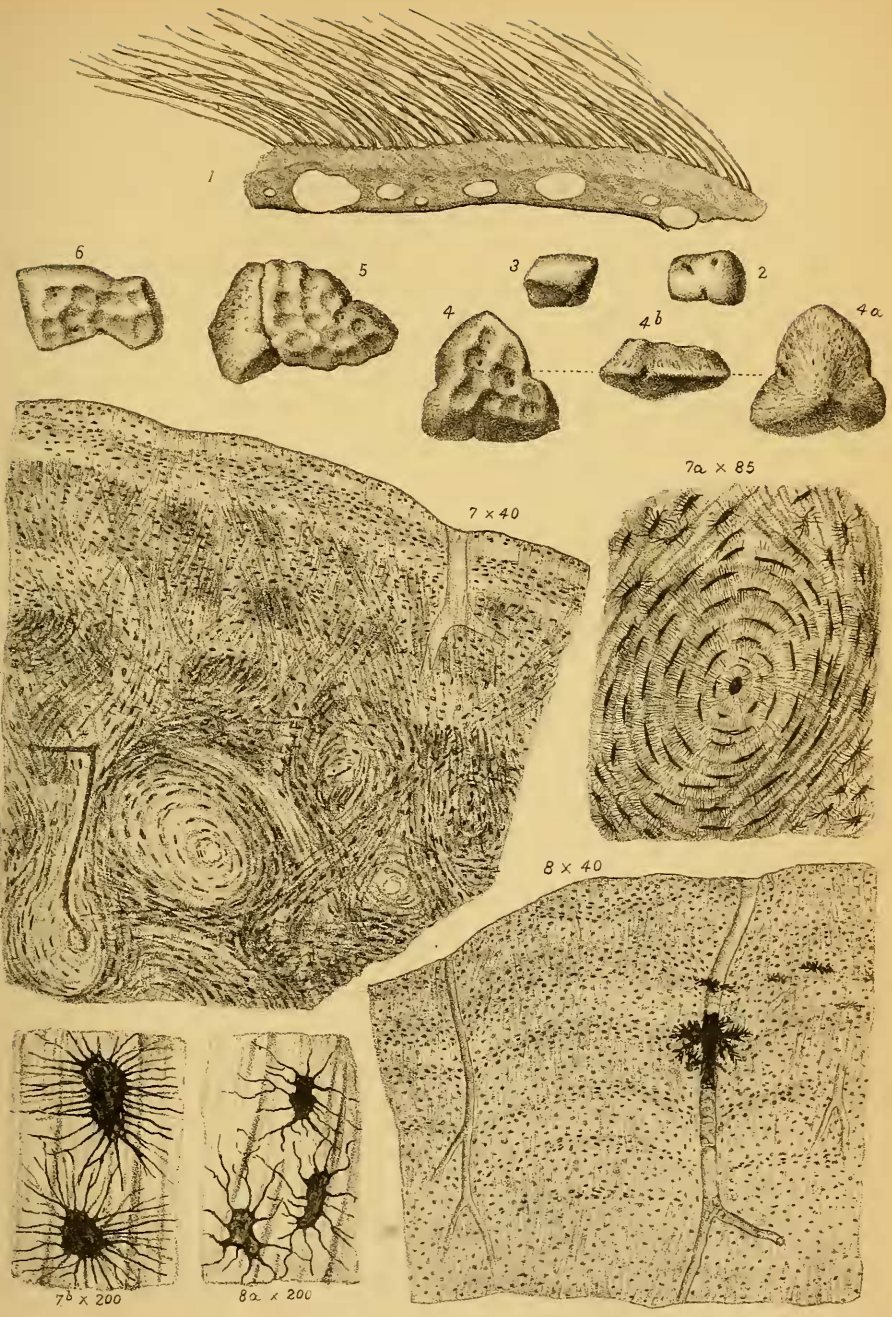
[Received February 21, 1899.]

(Plates XIII.–XV.)

1. Account of the Discovery. By Dr. Moreno.

In November 1897 I paid a visit to that part of the Patagonian territory which adjoins the Cordillera of the Andes, between the 51st and 52nd degrees of South latitude, where certain surveyors, under my direction, were carrying out the preliminary studies connected with the boundary-line between Chile and Argentina; and in the course of this expedition I reached Consuelo Cove, which lies in Last Hope Inlet. In that spot, hung up on a tree, I found a piece of a dried skin, which attracted my attention most strangely, as I could not determine to what class of Mammalia it could belong, more especially because of the resemblance of the small incrusted bones it contained to those of the Pampean *Mylodon*. On inquiring whence it came, I was informed that it was only a fragment of a large piece of skin which had been discovered two years before, by some Argentine officers, in a cavern which existed in the neighbouring heights. Immediately on receiving this news, I hastened to the spot, guided by a sailor who had been present when the original discovery had been made. As, at that moment, I had no means of making more than a few hurried excavations, which gave no further traces of the discovery, I left orders that the search should be continued after my departure; but this once more also failed to give any ultimate results. Nothing could be found but modern remains of small rodents, and these chiefly on or near the surface of the ground. From the most careful inquiries which I set on foot, it appeared that, when the first discovery was made, no bones were found, the skin being half buried in the dust which had accumulated from the gradual falling away of the roof of the cavern, composed of Tertiary Conglomerate. It was only in the broad entrance to the cavern that were found a few human bones, borne thence to the shore of the Cove and afterwards broken up.

As already stated, the skin here presented to you formed but a small part of a larger one. One small piece had been carried off



P. Highley del. et lith.

Hanhart imp.

NEOMYLODON LISTAI.

by Dr. Otto Nordenskjöld, and others by officers of the Chilian navy, who later on had visited the spot. The inhabitants of the locality looked upon it as an interesting curiosity, some of them believing that it was the hide of a cow incrusted with pebbles, and others asserting that it was the skin of a large Seal belonging to a hitherto unknown species.

In Consuelo Cove, I embarked on board a small Argentine transport, which had been placed at my disposal to carry out the study of the western coast as far as Port Montt, in latitude 42°. At this latter place I left the steamer, which then proceeded to make a series of surveys. These lasted until her return to La Plata, at the latter end of July 1898, when she brought back to me the fragment of skin in question.

This is an accurate and true version of the discovery of this skin, which gave rise to the publication of Señor Ameghino's small pamphlet[1], in which he gave an account of the discovery of a living representative of the "Gravigrades" of Argentina, distinguishing it by the name of "*Neomylodon listai*."

I have an idea that Señor Ameghino never saw the skin itself, but only some of the small incrusted bones, of which he had obtained possession. The vague form in which he draws up his account compels me to believe this suspicion to be true.

My opinion is that this skin belongs to a genuine Pampean *Mylodon*, preserved under peculiar circumstances resembling those to which we owe the skin and feathers of the Moa. I have always maintained that the Pampean Edentates, now extinct, disappeared only in the epoch which is called the historical epoch of our America. In the province of Buenos Aires, buried chiefly in the humus, I have found remains of *Panochthus*, and others of the same *Mylodon* from the sea-shore, all of which present the same characteristic marks of preservation as the remains of human beings discovered in the same spot. In this identical layer of the sea-shore, close to the bones I have also found stones polished by the hand of man, and flints cut like those found in the Pampean formation. In 1884, in a cavern near to the Rio de los Patos, in the Cordillera, I discovered some paintings in red ochre, one of which, in my opinion, resembles the *Glyptodon* on account of the shape of the carapace.

Ancient chroniclers inform us that the indigenous inhabitants recorded the existence of a strange, ugly, huge hairy animal which had its abode in the Cordillera to the south of latitude 37°. The Tehuelches and the Gennakens have mentioned similar animals to me, of whose existence their ancestors had transmitted the remembrance; and in the neighbourhood of the Rio Negro, the aged cacique Sinchel, in 1875, pointed out to me a cave, the supposed lair of one of these monsters, called "Ellengassen"; but I must add

[1] F. Ameghino, "Première Notice sur le *Neomylodon listai*, un Représentant vivant des anciens Edentés Gravigrades fossiles de l'Argentina" (La Plata, August 1898); translated under the title "An Existing Ground-Sloth in Patagonia," in 'Natural Science,' vol. xiii. (1898), pp. 324-326.

that none of the many Indians with whom I have conversed in Patagonia have ever referred to the actual existence of animals to which we can attribute the skin in question, nor even of any which answer to the suppositions of Señor Ameghino according to Señor Lista. It is but rarely that a few Otters (*Lutra*) are found in the lakes and rivers of the Andes, as in the neighbourhood of Lake Argentino, in the 'Sierra de las Viscachas,' and in the regions which I believe Señor Lista visited, there are only a few scarce Chinchillas (*Lagidium*), which have a colouring more dark greyish than those found to the north, and are in every case separated from these by a large extent of country.

The Pampean Edentata have in former days certainly existed as far south as the extreme limit of Patagonia. In 1874, in the bay of Santa Cruz, I met with the remains of a *pelvis* of one of these animals in Pleistocene deposits, and also remains of the mammals which are found in the same formation, such as the *Macrauchenia* and *Auchenia*. It would not be astonishing that the skin of one of these should have been preserved so long, because of the favourable conditions of the spot in which it was found.

The state of preservation of this piece of skin, at first sight, makes it difficult for one to believe it to be of great antiquity; but this is by no means an impossibility, if we consider the conditions of the cave in which it was found, the atmosphere of which is not so damp as one might at first imagine it to be, although it is situated in the woody regions near to the glaciers and lakes. It is well to mention that in 1877, under similar conditions, and in a much smaller cave, scarcely five metres from the waters of Lake Argentino, situated 60 miles more to the north, I discovered a mummified human body painted red, with the head still covered in part with its short hair wonderfully preserved, and wrapped up in a covering made of the skin of a Rhea, and holding in its arms a large feather of the Condor, also painted red; this was all covered up with a layer of grass and dust fallen from the roof of the cave. In another cave in the neighbourhood I discovered a large trunk of a tree, painted with figures in red, black, and yellow. The sides of the rock close to the entrance of the cave were covered with figures, some representing the human hand, others combinations of curved, straight, and circular lines, painted white, red, yellow, and green. Now, this mummy, which is preserved in the Museum of La Plata, does not belong to any of the actual tribes of Patagonia. Its skull resembles rather one of those more ancient races found in the cemeteries in the valley of the Rio Negro—a most interesting fact, since they belong to types which have completely disappeared from the Patagonian regions, and it is well known that the actual Tehuelches may be considered to have been the last indigenous races which reached the territory of Patagonia. Many a time the Tehuelches have spoken to me of these caves as abodes of the evil "spirits," and of the enigmatical painted figures they contained: some attributed the latter to these same "spirits," others to men of other races, of whom they have no recollection. In another cave,

PHOTOGRAPH FROM INSIDE OF THE CAVERN NEAR CONSUELO COVE, LAST HOPE INLET, PATAGONIA, LOOKING OUTWARDS.

+ marks the spot where the piece of skin of *Neomylodon listai* was found buried in earth.

four hundred miles further to the north, in 1880, I discovered other human bodies, more or less mummified and in good preservation, but of a different type, and beside them some painted poles which served to hold up their small tents, the use of which had already disappeared more than three centuries ago; together with the upper part of the skull of a child perfectly scooped out like a cup. And yet the historical Tehuelches, the same as all the indigenous races in the southern extremity of South America, hold their dead in great respect, and never use such drinking-vessels.

These proofs of the favourable conditions of the climate and of the lands near to the Cordillera, which are revealed to us by the preservation of objects undoubtedly dating from very remote epochs, strengthen my opinion that this skin of a huge mammal, which has long since disappeared, may well have been preserved till the present time.

I exhibit a photograph of the cave in which the specimen was found (reproduced on the preceding page). I may add that a further careful search is now being made in the earth forming the floor of the cave, and I hope in due time to have the honour of communicating the results to this Society.

2. Description and Comparison of the Specimen. By A. Smith Woodward.

(a) *Description.*

The problematical piece of skin discovered by Dr. Moreno measures approximately 0·48 m. in the direction of the main lie of the hair, while its maximum extent at right angles to this direction is about 0·55 m. The fragment, however, is very irregular in shape; and it has become much distorted in the process of drying, so that the anterior portion, which is directed upwards in the drawing, Pl. XIII., is bent outwards at a considerable angle to the main part of the specimen which will be claimed to represent the back. The skin, as observed in transverse section, presents a dried, felt-like aspect; but there is a frequent ruddiness, suggestive of blood-stains, while the margin above the point marked B (Pl. XIII.) and to the right of E (Pl. XIII.) exhibits distinct indications of freshly dried once-fluid matter, which Dr. Vaughan Harley has kindly examined and pronounced to be serum. Its outer face is completely covered with hair, except in the region marked C and above B, where this covering seems to have been comparatively fine and may have been accidentally removed. The inner face of the skin (Pl. XIV.) is only intact in a few places (*e. g.* where marked G), the specimen having contracted and perhaps been somewhat abraded, so that a remarkable armour of small bony tubercles, irregularly arranged and of variable size, is exposed over the greater part of it, and especially well in the regions marked F. At one point, marked B in Pl. XIII., there is an irregular rounded hole about

0·02 m. in diameter, which might possibly have been caused by a bullet or a dagger, but in any case was probably pierced when the skin was still fresh. Owing to its direction, this hole is partly obscured by the overhanging hair in Pl. XIII.

The skin in its dried state varies in thickness in different parts. The average thickness of the flattened portion, which must be referred to the back, is shown by the cleanly-cut right margin of the specimen to be 0·01 m. This is slightly increased towards the posterior (lower) end of the border; while above it, at E, the thickness becomes 0·015 m. The latter thickness also seems to be attained in the much-shrivelled corner marked C—a circumstance suggesting bilateral symmetry between at least part of the two anterior outer angles of the specimen. The thinnest portion preserved is the border above B; and the skin must also have been comparatively thin in the region of the accidental notch to the left, considerably below C.

The portion of skin above B is interesting not only from its relative thinness, but also from the occurrence of an apparently natural rounded concavity in the margin. This excavation, which measures 0·05 m. along the curve, is marked by the remains of a thin flexible flap, which is sharply bent outwards, and is covered with short hairs on its outer face. It is especially suggestive of the base of an ear-conch; and if this appearance be not deceptive, it is worthy of note that the dried skin hereabouts and in the region which would have to be interpreted as cheek (C) is much more wrinkled than elsewhere.

As already mentioned, the outer aspect of the skin is completely covered with hair, which is very dense everywhere except on the left anterior corner. Here it seems to have been removed by abrasion. A small patch of hair has also clearly been pulled out near the gap in the left border of the specimen; and close to the middle (where marked D) there is a small hairless depression which may perhaps be interpreted as a wound inflicted and healed during life. The hair is only of one kind, without any trace of under-fur, and it is still very firmly implanted in the skin, without signs of decay. Its arrangement seems to be quite regular, there being no tendency towards its segregation into small groups or bundles. It is of a uniform dirty yellowish or light yellowish-brown colour, and, making due allowance for slight ruffling and distortion of the specimen, it may be described as all lying in one direction, vertically in the drawing (Pl. XIII.), except at the two upturned anterior corners of the specimen, where there is an inclination from the right and left respectively towards the centre. The longest hairs, which usually measure from 0·05 m. to 0·065 m. in length, are observed in the half of the specimen in front of (above) the letter D. Those in the middle of the extreme anterior (upper) border measure from 0·03 m. to 0·05 m. in length, those at the hinder (lower) border about the same; while some of the comparatively small and delicate hairs on the supposed cheek are not longer than 0·01 m. The hairs are stiff, straight, or only very slightly wavy,

and all are remarkably tough. Examined under the microscope, their cuticle is observed to be quite smooth, while the much-elongated cells of the cortex are readily distinguishable. Mr. R. H. Burne has kindly made some transverse sections, which prove the hairs to be almost or quite cylindrical, and none of the specimens examined present any trace of a medulla.

The dermal ossicles are very irregular in arrangement, but are to be observed in every part of the specimen, even in the comparatively thin region near the supposed ear. They form everywhere a very compact armour, and some of them are quite closely pressed together; rarely, indeed, there is a shallow groove crossing a specimen, possibly indicating two components which were originally separate. As shown by every part of the cut margin, and especially well in a small section prepared by Prof. Charles Stewart (Pl. XV. fig. 1), they are all confined to the lower half of the dermis, never encroaching upon the upper portion in which the hair is implanted. It is also to be observed that where the inner surface of the skin is intact (*e. g.* around G in Pl. XIV.), the ossicles are completely embedded and only faintly visible through the dry tissue. The exposure of a considerable number of them, as already mentioned, is due to the rupture and partial abrasion of this surface. No tendency to arrangement in parallel lines or bands can be detected; and large and small ossicles seem to be indiscriminately mingled, although of course allowance must be made, in examining sections and the abraded inner view of the skin, for differences in the plane of adjoining sections and varying degrees of exposure by the removal of the soft tissue. The largest ossicles are oblong in shape when viewed from within, and measure approximately 0·015 m. by 0·010 m.; but the majority are much smaller than these. They are very variable and irregular in form; but their inner face is generally convex, sometimes almost pyramidal, while the outer face of the few which have been examined is slightly convex, more or less flattened, without any trace of regular markings (Pl. XV. figs. 2, 3).

In microscopical structure the dermal ossicles are of much interest, and I have examined both horizontal and vertical sections, one of the former kindly prepared by Prof. Charles Stewart. A portion of a horizontal section is shown enlarged about 40 times in Pl. XV. fig. 7; and one of the Haversian systems from its middle area is represented, much more highly magnified, in fig. 7 *a*. The tissue is traversed in all directions by a dense mass of interlacing bundles of connective-tissue fibres, which exhibit an entirely irregular disposition, except quite at the periphery of the ossicle. Here they are less dense and are arranged in such a manner as to form at least one darkened zone concentric with the margin in the comparatively translucent border. Occasionally, but not at all points, the fibres in this peripheral area may be observed to radiate regularly outwards. Numerous small vascular canals, frequently branching, are cut in various directions; and the bony tissue, which is developed in every part of the ossicle, exhibits abundant

lacunæ. Nearly everywhere, except in the narrow peripheral area just mentioned, it is easy to recognize the bony laminæ arranged in Haversian systems round the canals; and most of the lacunæ between these laminæ are excessively elongated, with very numerous branching canaliculi, which extend at right angles to their longer axis. Near the margin of the ossicle, especially in its more translucent parts, the bone-lacunæ are less elongated, more irregular in shape, and apparently not arranged in any definite order (Pl. XV. fig. 7 *b*). There is no clear evidence of bony laminæ concentric with the outer margin, though appearances are sometimes suggestive of this arrangement. A vertical section of an ossicle presents exactly the same features as the horizontal section now described. It is thus evident that the vascular canals with their Haversian systems of bone have no definite direction, but are disposed in an entirely irregular manner.

Taking into consideration all characters, and making comparisons with the aid of my friend Mr. W. E. de Winton, I am inclined to regard the fragmentary specimen as the skin of the neck and shoulder-region with part of the left cheek. The apparent bilateral symmetry between at least part of the thickened anterior outer angles of the specimen has already been noted; and if this observation be well-founded, the middle line of the back extends vertically down the middle of the figure, Pl. XIII. If the rounded notch above B be the base of the external ear, as seems probable, the thick wrinkled skin (C) with fine short hair still further to the left must be the cheek. The ear and cheek on the right side have been removed; but at the base of the outwardly-turned angle on this side of the specimen there are the very long hairs which occupy a similar position on the left. It thus seems possible to estimate the transverse measurement between the ears as from 0·25 m. to 0·30 m., which corresponds with a tentative estimate of the same distance in *Mylodon robustus* based on a skull in the British Museum.

(b) *Comparisons and General Conclusions.*

The skin now described differs from that of all known terrestrial Mammalia, except certain Edentata, in the presence of a bony dermal armour. There can therefore be little doubt that the specimen has been rightly referred to a member of this typically South-American order. Even among the Edentates, however, the fragment now under consideration is unique in one respect; for all the ossicles are buried deeply in the lower half of the thickened dermis and the hairs are implanted in every part of its upper half, whereas all the forms of bony armour hitherto described in this order reach the outer surface of the dermis and are merely invested with horny epidermis. This is the case, as is well known, in the common existing Armadillos, in which the hair is only implanted in the dermis between the separate parts of the armour. Even in the unique and remarkable skin of an Armadillo from Northern Brazil, described by Milne-Edwards under the name of

Scleropleura bruneti[1], the bony plates and tubercles are still covered only by epidermis, although most of them are reduced to small nodules and might well have sunk more deeply into the abnormally hairy skin. There is also reason to believe that in the gigantic extinct Armadillos of the family Glyptodontidæ the same arrangement of dermal structures prevailed; for one specimen of *Panochthus tuberculatus* obtained by Dr. Moreno for the La Plata Museum actually shows the dried horny epidermis in direct contact with the underlying bone, and seems to prove that the numerous perforations in the Glyptodont dermal armour were not for the implantation of hairs (as once supposed), but for the passage of blood-vessels to the base of the epidermal layer. Similarly, among the extinct Ground-Sloths of the family Mylodontidæ dermal ossicles have been found with the remains of *Cœlodon*[2] and various forms (perhaps different subgenera) of *Mylodon*; but the only examples of this armour yet definitely described[3] exhibit a conspicuously sculptured outer flattened face, and it thus seems clear that Burmeister was correct in describing them as originally reaching the upper surface of the dermis and only covered externally by a thickened epidermis. Three such dermal tubercles, now in the British Museum, are shown of the natural size in Pl. XV. figs. 4–6. It is, however, to be noted that Burmeister himself actually observed armour of this kind covering only the lumbar region of the trunk. He believed that the other parts of the animal were similarly armoured, because he had found "the same ossicles" on the digits of the manus, where they were "generally smaller and more spherical"; but he unfortunately omits to make any explicit statement as to the presence or absence of the characteristic external ornamentation on the latter.

The omission just mentioned is especially unfortunate because on careful comparison it is evident that the irregular disposition of the small ossicles in the piece of skin now under consideration is most closely paralleled in the dermal armour of the extinct *Mylodon*, as already observed by Drs. Moreno and Ameghino. There is obviously no approach in this specimen to the definite and symmetrical arrangement of the armour such as is exhibited both by the existing Armadillos and the extinct Glyptodonts. There are, then, two possibilities. Either the dermal armour of *Mylodon* varied in different parts of the body, being sculptured and covered only by epidermis in the lumbar region, while less developed, not sculptured but completely buried in the dermis in the comparatively flexible neck and shoulder region—in which case Dr. Moreno may be correct in referring the problematical specimen to *Mylodon*; or the dermal ossicles of

[1] A. Milne-Edwards, "Note sur une nouvelle Espèce de Tatou à cuirasse incomplète (*Scleropleura bruneti*)," Nouv. Arch. Mus. vol. vii. (1871), pp. 177–179, pl. xii.

[2] P. W. Lund, K. Dansk. Vidensk. Selsk. Afhandl. vol. viii. (1841), p. 85 (footnote).

[3] H. Burmeister, Anales Mus. Publico Buenos Aires, vol. i. (1864–69), p. 173, pl. v. fig. 8.

this extinct genus may have been uniform throughout, only differing in size and sparseness or compactness—in which case Dr. Ameghino is justified in proposing to recognize a distinct genus, *Neomylodon*.

To decide between these two possibilities, it is necessary to wait for additional information concerning the anterior dorsal armour of *Mylodon* as precise as that published by Burmeister in reference to the lumbar shield. Meanwhile it must suffice to compare the microscopical structure of the ossicles from the new skin with that of the small sculptured tubercles of undoubted *Mylodon* represented in Pl. XV. figs. 4–6. Part of a horizontal section of one of these fossil ossicles is shown enlarged about 40 times in Pl. XV. fig. 8. It must be remembered that the specimen has been buried in the Pampa Formation for a long period, and that the oxides of iron and manganese have infiltrated the margin of the bone, rendering the structure of its outer border more conspicuous than that of its central portion. It must also be noted that some of the manganese has assumed its familiar "dendritic" aspect, in this respect presenting appearances not due to original structure. The calcified interlacing fibres of connective tissue are as abundant here as in the ossicle of the so-called *Neomylodon*; but in a very wide peripheral area they exhibit a marked radial disposition, nearly everywhere extending in bundles at right angles to the border. Rather large vascular canals, infiltrated with the oxides of iron and manganese, are observed in places, often bifurcated and usually bordered by a transparent zone free from the connective-tissue fibres. Well-developed bone-lacunæ are very abundant, many exhibiting short branching canaliculi (Pl. XV. fig. 8 *a*), and most of the others very irregular in shape, evidently furnished with canaliculi which cannot be seen from lack of infiltration. The lacunæ are never much elongated, and are not arranged in distinctly differentiated Haversian systems in any part of the section; while the only regular disposition of the bony laminæ is traceable near the circumference, where the lacunæ are frequently arranged or clustered in parallel zones concentric with the border. A vertical section of one of the same specimens shows the connective-tissue fibres radiating outwards towards the lateral margins, but not directly towards the upper sculptured face. There are no bony laminæ clearly parallel with the latter face, and at least one vascular canal in transverse section seems to be the centre of a Haversian system.

The histological structure of the ossicles in the skin now under consideration thus resembles that of the sculptured tubercles of *Mylodon* in all essential features, but differs in two noteworthy respects. In the ossicles of the so-called *Neomylodon*, as already described, the fibres of connective tissue do not exhibit much definite radiation towards the lateral margin; while the bony tissue at most points is disposed in definite Haversian systems. There is thus enough discrepancy to justify the suspicion that the new and the old specimens do not belong to the same animal.

In fact, so far as the differentiation of the dermal bone is concerned the so-called *Neomylodon* is precisely intermediate between *Mylodon* and the existing Armadillo (*Dasypus*); sections of the scutes of the latter animal, both in the Royal College of Surgeons and in the British Museum, showing that in this genus nearly the whole of the osseous tissue is arranged in Haversian systems, although abundant interlacing connective-tissue fibres are still entangled in it, at least near the border.

If the characteristic dermal armature does not suffice for the definite expression of an opinion as to the precise affinities of the specimen, a still less satisfactory result can be expected from a comparison of the hair. For, in the first place, no hair has hitherto been discovered in association with the skeleton of any extinct Ground-Sloth; while, secondly, the hairy covering of a mammal is perhaps that part of its organization most readily adapted to the immediate circumstances of its life. So far as their endoskeleton is concerned, the extinct Mylodonts and their allies are precisely intermediate between the existing Sloths and Anteaters; they combine "the head and dentition of the former with the structure of the vertebral column, limbs, and tail of the latter"[1]. It might therefore be supposed that the hair of this extinct group would exhibit some of the peculiarities of that in one or other of its nearest surviving relatives. The epidermal covering of the piece of skin now described, however, entirely lacks the under-fur which is so thick in the Sloths; while the structure of each individual hair, with its smooth cuticle and lack of a medulla, is strikingly different from that observed both in the Sloths and Anteaters, and identical with that of the hair in the surviving Armadillos. The large hair in the Sloths and *Tamandua* exhibits a conspicuously scaly cuticle; while that of *Myrmecophaga* is remarkable for its very large medulla. All these animals now live in the tropics, either in forests or swamps, whereas the Patagonian animal must have existed under circumstances much like those under which the Armadillos still survive. Hence the characters of the hair of the so-called *Neomylodon* may be of no great importance in determining the affinities of the animal, but may represent a special adaptation to its immediate environment.

Finally, there is the question of the antiquity of the problematical skin. On two occasions I have examined the mummified remains of the extinct Mammoth and Rhinoceros from Siberia in the Imperial Academy of Sciences at St. Petersburg; I have also carefully studied the remains of the neck and legs of the Moa from a cavern in New Zealand, now in the British Museum. Compared with these shrivelled and dried specimens, the piece of skin from Patagonia has a remarkably fresh and modern aspect; and I should unhesitatingly express the opinion that it belonged to an animal killed shortly before Dr. Moreno recognized its interest, had he not been able to give so circumstantial an account of its discovery and strengthened his point of view by recording the

[1] Flower and Lydekker, 'Introduction to the Study of Mammals,' p. 183.